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five to the right of 22; but 24 should be 6 spaces to the right of 23. The shift is 6 spaces for all centuries divisible by 4 and 5 spaces for the other centuries. This may be continued to any desired extent and may be extended backwards to the beginning of the calendar.

It is easy to see from the figure that there must be at least 13 columns on the main slide of this particular form of the calendar. With the given position of the centuries it is necessary to have 18 columns on the auxiliary slide. This number might have been reduced by one; but there would then have been a loss in symmetry in two parts. Other forms of the calendar allow different parts to move. A common type has the parts on disks, which rotate with respect to one another. Still another type uses one or more of the parts as reference tables.[1] However, the theory which I have given is applicable to practically all types.

II. Note on the Computation of Logarithms.

By Albert A. Bennett, University of Texas.

The following approximate relations are easily verified by the use of a computing machine or by direct multiplication with paper and pencil, and without recourse to logarithms. (The writer checked these on a "Monroe" in about two hours.)

(1) $(1.024)^{214} = 160.02580 \cdots$,
(2) $3\,(9/8)^{18} = 24.99577 \cdots$,
(3) $2 \times 5 = 10$,
(4) $7\,(98/81)^4 = 14.998996 \cdots$,
(5) $((2.2)^3\,(2.1))^2 = 500.005377 \cdots$,
(6) $39\,(13/14)^6 = 25.000945 \cdots$,
(7) $25\,(17/14)^5 = 66.000071 \cdots$,
(8) $20\,(190/33)^2 = 662.9936 \cdots$,
(9) $13\,(11/10)^2\,(17/13)^4 = 45.9992752 \cdots$,
(10) $551\,(55/221)^2\,(23/39)^3 = 6.9997431 \cdots$.

If these relations be replaced by the approximate relations

(1′) $(1.024)^{214} = 160$,
(2′) $3\,(9/8)^{18} = 25$,
(3′) $2 \times 5 = 10$,
(4′) $7\,(98/81)^4 = 15$,
(5′) $((2.2)^3\,(2.1))^2 = 500$,
(6′) $39\,(13/14)^6 = 25$,
(7′) $25\,(17/14)^5 = 66$,
(8′) $20\,(190/33)^2 = 663$,
(9′) $13\,(11/10)^2\,(17/13)^4 = 46$,
(10′) $551\,(55/221)^2\,(23/39)^3 = 7$,

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[1] A very interesting example of this type is given by Augustus De Morgan in a volume of 88 pages entitled *The Book of Almanacs.* In addition to what is given by the ordinary perpetual calendar, his book includes saints' days, lunar calendars, several special calendars and discussions of historical interest.

and the logarithms to the base 10 be found formally, these reduce respectively, to the following:

(1″) $2136 \log 2 = 643,$
(2″) $37 \log 3 = 2 + 52 \log 2,$
(3″) $\log 5 = 1 - \log 2,$
(4″) $9 \log 7 = 1 - 5 \log 2 + 17 \log 3,$
(5″) $6 \log 11 = 11 - 7 \log 2 - 2 \log 3 - 2 \log 7,$
(6″) $7 \log 13 = 2 + 4 \log 2 - \log 3 + 6 \log 7,$
(7″) $5 \log 17 = -2 + 8 \log 2 + \log 3 + 5 \log 7 + \log 11,$
(8″) $2 \log 19 = -3 - \log 2 + 3 \log 3 + 2 \log 11 + \log 13 + \log 17,$
(9″) $\log 23 = -2 - \log 2 + 2 \log 11 - 3 \log 13 + 4 \log 17,$
(10″) $\log 29 = -2 + 2 \log 2 + 3 \log 3 + \log 7 - 2 \log 11 + 5 \log 13$
$+ 2 \log 17 - \log 19 - 3 \log 23.$

These relations may be used as recursion equations to determine approximately the logarithms of the first few primes. When solved successively it is found that log 2 is given correctly to six places, so that its powers up to 1024 are correct to five places, and each of the other primes has its logarithm given correctly to at least five decimal figures.

These relations are found to be ample for completing correctly the construction of a four-place logarithm table, by use of linear interpolation when once the logarithms of all numbers of three significant figures or less, obtainable as powers and products of the above primes, have been written down. For example, between the logarithm of 23 and the logarithm of 29, we have without interpolation and by mere use of the fact that the logarithm of a product is equal to the sum of the logarithms of the factors, the logarithms of 24, 25, 26, 27, 28, as well as of such numbers, for example as, 25.6. With a little ingenuity (such as would be illustrated in determining the logarithm of 7, from the logarithms of 2, 3, and 5, by the relation that 49, lies between 48 and 50), a five-figure table with at most very few errors can be obtained from the above relations.

These relations have been found by an extension of the continued fraction algorithm, and for the accuracy desired simpler relations do not appear to exist. This alternative method of constructing or checking logarithm tables is believed to be new.

RECENT PUBLICATIONS.

REVIEWS.

A First Course in Nomography. (Bell's Mathematical Series.) By S. BRODETSKY. London, G. Bell and Sons, 1920. 12 + 135 pages. Price 10 shillings.

Preface: "In many branches of science, in engineering practice, in technology, in industry and in military science, Nomography is a recognized means of carrying out graphical calculations. The ballistic constant in gunnery, flame temperature in the research of coal-gas combustion, the angle of twist in a thread of given thickness with a given number of turns per inch, the conversion of counts in the textile industry, can all be calculated by means of nomograms. Nomographic